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Estimation of local incidence of jellyfish envenomation in developed marine coastal areas and large populated island on the western coast of Peninsular Malaysia using case surveillance of government health facilities in Manjung, Perak and Langkawi Island

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ABSTRACT

Background: *Jellyfish stings are one of the commonest causes of marine animal related injuries in human. Despite mostly being harmless, box jellyfish species can cause major stings with fatalities or systemic envenoming symptoms. There are 15–20 species identified to be life-threatening. There are few reported cases that suggest the presence of deadly box jellyfish in the Malaysian coast. However, numbers of stings around Malaysia are still under reported.*

Materials and methods: *This observational study was conducted in Manjung, Perak and Langkawi Island to look at the pattern and incidence of jellyfish stings which occur within 1 year.*

Results: *There were 45 sting incidents reported with the highest number of cases occurred in December and February. Cases mainly involved young adults aged 10 to 29 years old. The most common clinical symptom that presented was sudden and persistent pain. Vinegar was applied as first aid in 53.3% of reported stings. All patients were treated symptomatically and discharged well. Stings occurred at mean sea surface temperature of 29.38°C and the wind speed of 7.6 knots. All cases were mild and did not require antivenom.*

Conclusions: *The study showed that the occurrence of jellyfish stings are affected by weather conditions. Jellyfish stings occur seasonally, thus making it predictable and easily preventable with public awareness, early first aid application and use of jellyfish nets.*

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Key words: clinical toxinology, emergency, first-aid, jellyfish stings

INTRODUCTION

About 150 million marine envenomations occur annually with jellyfish as the commonest stings. Very few require medical attention other than basic first aid. However, there are identified fatal jellyfish which are medically significant to humans. These jellyfish are from the cubozoan class, the box jellyfish [1–3]. Box jellyfish are further divided into two subgroups, the Chirodropids and Carybdeid. The management of jellyfish envenomation must be initiated early and the primary management should be directed at alleviating

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the local effects of toxins, prevention of further discharge of toxins and systemic reaction control [4]. The most important steps after envenomation is basic life support with the aim of maintaining good respiration and normal blood circulation, and appropriate first aid management to prevent continuous release of toxins and alleviate pain [4]. Toxins are varied among jellyfish stings; thus different remedies are necessary to control the effects of envenomation. In addition to initial first aid management, patients may require adequate intravenous analgesia, particularly opioids, to relieve pain. Box jellyfish antivenom is indicated once the patient develops systemic envenomation such as life-threatening cardiac or respiratory depression, cardiac arrhythmias, unconsciousness or for patients who suffer from severe persistent pain despite first aid management and parenteral narcotics [5, 6]. There are a few reported cases suggestive of fatal or near fatal cases of box jellyfish envenomation in Malaysia [1, 7–9]. A study conducted along the Malacca strait in 2010 reported the presence of deadly box jellyfish *Chiropsoidis buitendijki* and *Carybdeid morbakka* in Penang and Manjung. The *Carybdeid morbakka* are similar to one that was found in Hawaii which causes Irukandji syndrome. Even though a few studies and cases prove the existence of deadly jellyfish in Malaysian coast, the data is still limited and studies are still lacking. Thus, the prediction of jellyfish blooms around the Malaysian coast and the management of the stung are poorly understood.

Therefore, this study was conducted to determine the frequency of jellyfish stings, the clinical spectrum of jellyfish toxin, common medical practice in managing the victims, and to determine any correlation between the incidence of jellyfish stings with weather and sea changes.

MATERIALS AND METHODS

This was a prospective observational study of jellyfish stings in Manjung, Perak and Langkawi Island from 1 October 2017 to 31 November 2018. A standard data collection sheet was used for patients presenting to selected hospitals and health clinics. The variables of the study included demographics, weather and sea details, clinical presentation of jellyfish envenomation, nature of suspected sting, treatment details including first aid and medication given were recorded.

Patients with jellyfish envenomation detected by the primary care provider in charge of the clinic or hospital were enrolled in the study. The data collection sheets were filled during the visit. The weather and sea details data were provided by the Malaysia Meteorology Department.

RESULTS AND DISCUSSION

A total of 45 patients presented to the primary care centres for jellyfish stings were analysed. There were 9 cases in Manjung, Perak and 36 cases in Langkawi, Kedah (Figs, 1, 2).

Figure 1. Pangkor Island with the number of stings occurring mainly on the west coast of the island along the beaches of Tortoise Bay and Pasir Bogak

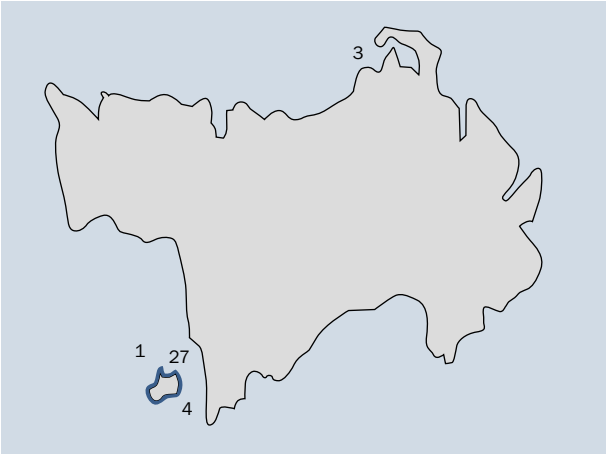

Figure 2. Langkawi Island with the number of stings occurring mainly along the southwestern beaches of Pantai Cenang. A few incidents documented at Tanjung Rhu beach in the north includes sting injuries from the harmful multi-tentacled Chironex species with one death incident. The incident location of one case was not documented

This study showed a seasonal pattern of jellyfish sting incidence that was higher in November, December and February (Fig. 3). There were no reported stings in July. This similar incidence was demonstrated in the first study done in Langkawi Island in 2012, where stings were higher throughout October to December [10]. This may be due to the surge of tourists to the Island as the local school holidays

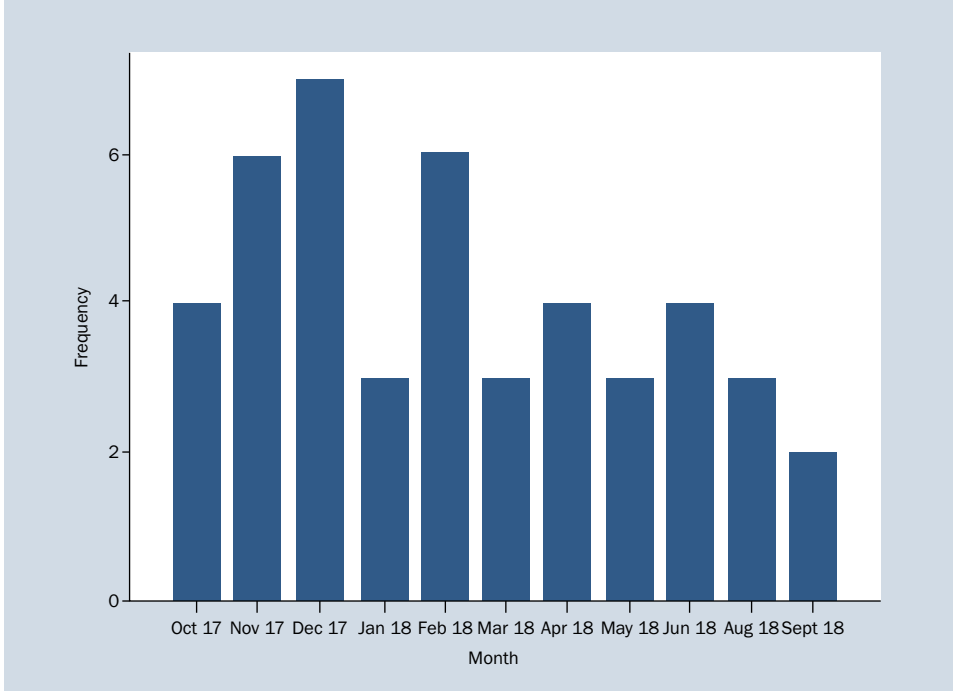

Figure 3. Number of patients treated for jellyfish sting according to months

fell within these months. In addition, sunny weather with lower average rainfall from November to February increased the risk of higher contact with jellyfish.

The highest jellyfish sting incidence happened in between 5 pm to 7 pm when most sea activities were held (Fig. 4). Activities associated with the risk of stings were swimming, and entering and standing in the water (Table 1). This shows that jellyfish stings were likely to occur at the seashore rather than within deep sea. This was due to jellyfish behaviour as they tend to drift along the current, becoming alienated onshore and along the coast [2].

Following jellyfish contact, most patients developed persistent pain over the sting area, generalised rashes, back pain, restlessness, headache, and profuse sweating (Table 2). These symptoms suggested the possibility of an Irukandji-like syndrome, a manifestation of venom-induced catecholamine storm. Intense pain may develop immediately, followed by systemic envenomation and associated symptoms. The clinical symptoms are usually delayed after 30 to 40 minutes and are diagnosed clinically. The classical clinical presentation is delayed onset of severe back and limb pain, sweating, hypertension, and in severe cases, evidence of cardiac dysfunction [6]. Two possible Irukandji syndromes have been reported in Langkawi in 2010 involving tourists who were stung by jellyfish that had developed severe chest pain, generalised muscle pain, intense local pain and nausea. They were treated with analgesia, with resolution of symptoms a few days later [9].

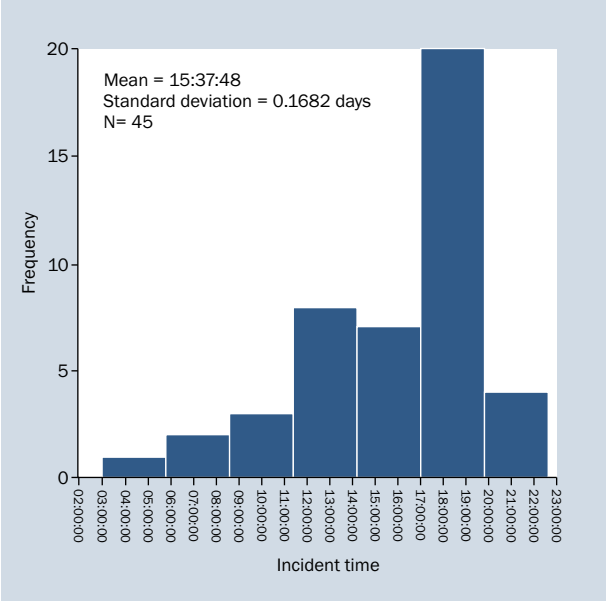

Figure 4. The incident time of jellyfish stings

Following contact with jellyfish, half of the patients had applied vinegar as first aid while 40% did not apply anything before arrival to the primary care centre. First aid is important to prevent new discharging nematocytes which may expose patients to further envenomation. Studies on vinegar to large box jellyfish showed deactivation of all undischarged venom-containing nematocysts. Be-

Table 1. Demographic characteristic of patients presenting with jellyfish stings

Characteristic	Number	Per cent	Mean	Standard deviation
Age [years]			23.44	14.3
0–9	8	17.8		
10–19	12	26.7		
20–29	12	26.7		
30–39	6	13.3		
40–49	5	11.1		
50–59	1	2.2		
60–69	1	2.2		
Gender				
Male	30	66.7		
Female	15	33.3		
Nationality				
Malaysian	30	66.7		
Non-Malaysian	15	33.3		
Activity during sting				
Entering the water	7	15.6		
Standing in the water	13	28.9		
Swimming	18	40.0		
Fishing in the shore	3	6.7		
Boating	4	8.9		

Table 2. Clinical presentation and treatment following jellyfish sting

Variable	Number	Per cent	Mean	Standard deviation
Clinical presentation				
Immediate pain	40	88.9		
Cardiorespiratory arrest	–	–		
Cardiac arrhythmias	–	–		
Loss of conscious	–	–		
Headache	3	6.7		
Back pain	5	11.1		
Generalised rashes	6	13.3		
Restlessness	4	8.9		
Profuse sweating	3	6.7		
Body surface area [%]			1.3	0.82
Body region sting by jellyfish				
Upper limb	21	42		
Lower limb	21	42		
Abdomen	1	2		
Head and neck	2	4		
Vital signs during presentation to primary care				
Blood pressure [mmHg]			122.34	17.6
Pulse rate [bpm]			94.18	16.7
Saturation [%]			98.53	0.26
Temperature [°C]			36.9	1.14
Pain score			5.31	2.11
Glasgow Coma Score (GCS)			15	0.00
First aid applied				
Vinegar	24	53.3		
None	18	40		
Sea water	1	2.2		
Others	2	4.4		
Medication				
Steroid	38	84.4		
Anti-histamine	28	62.2		
Opioids	22	48.9		
Nonsteroidal anti-inflammatory drugs (NSAIDS)	14	31.1		

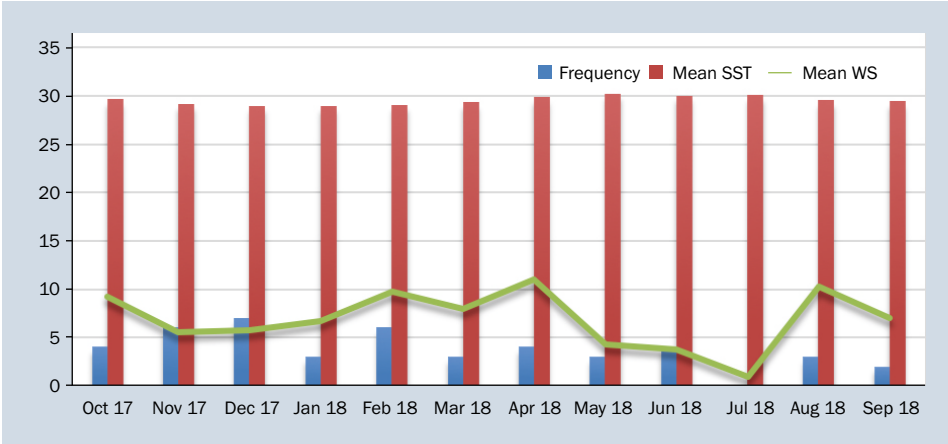

Figure 5. The association between frequency of incident, mean sea surface temperature (SST) and mean wind speed (WS) throughout the study period

Table 3. Weather details during jellyfish sting incident

Variable	Number	Per cent	Mean	Standard deviation
Weather:				
Clear	42	93.3		
Rainy	3	6.7		
Sea surface temperature [°C]			29.38	0.58
Wind speed [knot]			7.6	4.6
Tidal wave:				
High tide	23	51.1		
Low tide	22	48.9		

sides that, it has been shown to be effective in at least 5 species of carybdeid [11]. A box jellyfish sting victim had survived a severe envenomation despite a delay of 10 to 15 minutes of applying vinegar as first aid [12]. This shows vinegar is the best primary first aid of both carybdeid and chirodropid stings. Consequently, it is important for local authorities to provide vinegar at the seaside as it can prevent patients from developing severe envenomation while awaiting for emergency care services. Other first aid which can be used in the absence of vinegar is sea water. Fresh water application can cause discharge of the venom by changes in osmotic gradient causing severe envenomation and death.

Most patients were treated with steroids and anti-histamines. The analgesic of choice were opioids, compared to non-steroidal anti-inflammatory drugs. Most patients were treated with intravenous tramadol and fentanyl. Patients had immediate pain with a mean pain score of 5.31. Thus, opioid analgesic is appropriate in treating jellyfish stings. Other recommended agents which were used as analgesia were Magnesium sulphate, which serves as a peripheral inhibitor of catecholamine release and effect. It is usually given as a bolus, followed by infusion until the pain is controlled [6].

Weather had an influence on the rate of sting incidence (Fig. 5). Almost all stings occurred during clear weather with a mean sea surface temperature (SST) of 29.38°C and wind speed of 7.6 knots (Table 3). A study in Darwin showed a strong positive correlation between *Chironex fleckeri* stings and raised SST. Number of stings were higher when the SST was more than 30°C. Other studies showed similar results to this, with both *Chironex fleckeri and* Irukandji stings occurring at a mean temperature of 31.2°C [13]. With a higher mean SST in Manjung of 31.7°C, this predisposes to larger jellyfish blooms in this area [14]. Comparing *Chironex fleckeri and* Irukandji stings, both were prone to happen on 0-kot days. However, *Chironex fleckeri* stings happened more often during light wind while Irukandji stings occurred during moderate to strong wind [13].

All patients were treated symptomatically and were able to be discharged home. None required an antivenom due to the sting. Despite this, a few deaths related to jellyfish stings have been reported. The most recent was in Tanjung Rhu, Langkawi on 27th June 2018, when a Swedish tourist was

stung to death by a jellyfish. A similar incident occurred in February 2010 when a Swedish tourist was reported dead by jellyfish sting. Pulau Pangkor, Manjung had also reported a death of a 26-year-old Brunei tourist after contact with a jellyfish in 2000 [15]. This shows that even though all patients had presented to hospital with mild envenomation, deadly box jellyfish are still a threat in Malaysian waters. Box jellyfish antivenom are readily available in Malaysia. However, the antivenom is very limited and stored in hospital around Sabah. There is currently 5 in Queen Elizabeth Hospital, 3 vials in Kudat, Tawau, Lahat Datu, Semporna and Hospital Duchess of Kent Sandakan.

LIMITATION AND FUTURE DIRECTION

There were a few limitations of this study. This study is limited to patients who seek medical attention in these primary government health facilities. Sting victims may have seek treatment at private clinics, other health facilities or did not seek any treatment. The actual number of sting cases from these locations is likely to be significantly underestimated. The species of jellyfish which were responsible for the stings were unable to be identified as patients presented without any available samples for identification. Jellyfish species around Langkawi are still unknown as there is no study on jellyfish identification in Langkawi waters. A proper study should be conducted to determine the species of jellyfish as there were a few reported deaths in Langkawi attributed to jellyfish stings.

There were a total of 24 missing files that were identified. This shows poor documentation and case neglect by the healthcare providers. Remote Envenomation Consultation Services Malaysia provided a solution to this by collecting the data through electronic consultation.

CONCLUSIONS

This study identifies that patterns of jellyfish stings occur seasonally during clear weather, low average of rain falls and high sea surface temperature. The spectrum of presentation identified was similar to Irukandji syndrome. Envenomation was mild, not requiring antivenom and admission. We suggest the improvement of public awareness by placement of warning signs on beaches, pamphlets and jellyfish netting by local authorities and hotel management especially during higher seasons of jellyfish stings. Vinegar should be made available at local beaches to reduce the severity of jellyfish envenomation. Studies are very limited in this field despite several cases of life-threatening stings reported. More related studies are required for better understanding of the various harmful jellyfishes and to improve the clinical management of jellyfish envenomation.

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